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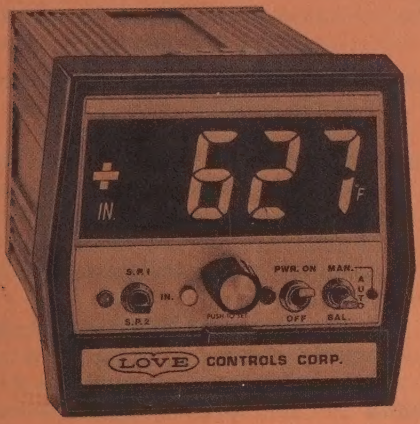
INSTRUCTIONS FOR MODELS 151, 152, 153, 1511, 1512, 1513, 1521, 1522, 1523, 1531, 1532 AND 1533 CONTROLLERS



If all else fails,
please read these instructions

LOVE®
CONTROLS CORPORATION
1475 S. WHEELING ROAD
WHEELING, ILLINOIS 60090
312 - 541-3232

INSTRUCTIONS FOR MODELS 151, 152, 153, 1511, 1512, 1513, 1521, 1522, 1523, 1531, 1532 AND 1533 CONTROLLERS

MODEL IDENTIFICATION

The model number for your controller appears on the back of the hinge down door on the front of the controller.

TWO SET POINT CONTROLLERS

Any of the following basic Models 151, 152, or 153 may be equipped with a second set point. Model designation for these models are made by using a suffix number. The following suffix numbers are used to designate the type of control on the second set point:

1 = On-Off 2 = Time Proportioning 3 = Limit

Therefore, a Model 151 with a limit second set point will become Model 1513.

MODEL 151 and 152 PROPORTIONAL CONTROLLERS

These models are equipped complete with power package for direct control of heater loads. The Model 151 has a self contained power package rated at 10 amperes up to 240 V.A.C., max. inrush 50A. The Model 152 has an external power package rated at 30 amperes up to 240 V.A.C., max. inrush 80A.

These models provide proportional power to the heaters to maintain the temperature for which the control is set. The proportional output occurs within an adjustable band around the set point called the proportional band. The band width is adjustable from 0.5% to 30% of span. Within this band, various power levels will be supplied to the heaters. At the very edge of the band, below set point, power to the heaters is 100%. As the controlled temperature enters the proportional band, the power supplied is diminished until the upper edge of the band is reached, where power would be 0%.

In addition, these models feature adjustable reset (integral) and rate (derivative). See "Operation".

MODEL 153 DRIVER CONTROLLER

This model is used to drive external SCR or Triac power units. It provides a zero crossover train of pulses capable of driving any SCR or Triac which requires a gate voltage of 5V. or less and a gate current of 100MA. or less. This model also has all of the control features of Models 151 and 152.

MOUNTING

Although the controller does not have to be removed from its housing for mounting, you may want to remove it to prevent any damage while mounting. To remove the controller from its housing, loosen

the jack screw located behind the hinge down door in the center of the lower edge of the controller. Turn the screw counter-clockwise until it turns free (it is captive and will not come out). Pull the controller forward to slide it out of the housing. To replace, slide controller into housing in its proper slots until the jack screw is engaged. Turn jack screw clockwise until tight. *Do not force it,* or the jack screw stud can be broken off. The jack screw automatically unplugs and replugs the controller.

All models mount in a 3 5/8 in. x 3 5/8 in. cutout. No other holes are required. Each controller is equipped with a special panel clip mounted on all four sides. The controller is simply pushed through the cutout until the panel stop on all four clips seats against the panel. If the controller has been removed from its housing, be sure the threaded jack screw stud is at the bottom of the housing. No screws or other mounting hardware are necessary.

Normally, the housing never has to be removed again since the rear terminal panel may be removed without taking the housing out of the panel. If it is necessary to take the whole housing out of the panel after it has been installed, place metal shim stock or other thin metal between the teeth in each clip and the edge of the cutout. This covers the teeth and prevents them from biting into the panel edge. Then push the housing out from the back of the panel.

Any controller may be mounted with its face tilted at any angle (back or forward) from vertical without any specification degradation. Always mount the controller so that the display is viewed directly. Due to the polarizers used in liquid crystal type displays, viewing from particular angles either up and down or sideways will dim the brightness of the display as it appears to the eye.

All controllers can be interchanged between housings of the same model only if they are calibrated for the same type of thermocouple. The reference junction compensator for the thermocouple type is located in the rear terminal panel. The thermocouple type, for which it is calibrated, is marked on both the inside and outside surface of the rear terminal panel. For example: controls of the same model calibrated for a type J thermocouple should be plugged into housings for that model having a type J rear terminal panel, K to K, R to R, etc.

The special panel clips, which hold the housing into the panel, will hold very firmly, even during shipment. However, if it is desirable to make the mounting more rigid, a #6 x 1/4 inch long binder head sheet metal screw may be inserted (using an offset screwdriver) through the hole provided in the inside of the housing just above the lower clip and below the upper clip. This must be done after the housing is in place in the panel. The screw will hold the panel clip rigidly against the panel edge. Be sure the screw is turned in all the way so that it does not interfer with sliding the controller into the housing and does not short to electronic components on circuit board.

Mount the Model 151 controller or the power units used with the Model 152 controller where the ambient temperature will not exceed 104°F. If this temperature is exceeded, the power unit rating will be decreased as follows:

Ambient °F.	Model 151	Model 151
104	10A.	25A.
112	9A.	24A.
120	8A.	21.5A
130	6A.	19.5A
140	5A.	17A.

Mount the Model 152 power unit so that the fins are perpendicular to ground level for best heat radiation. If mounted to a large metal surface, the Model 152 power unit can be used to 30 amperes.

GENERAL WIRING INFORMATION

Do not use unwired terminals as the tie points for other equipment.

It is advisable to fuse the incoming power line (to terminal 2) with a 15/100 amp. or .175 amp. slow-blow fuse. Be sure that it fuses the instrument power input only and not the load also.

The input transformer in your controller is protected by a thermostatic switch so that if the transformer overheats due to incorrect wiring, the control will automatically shut down until the transformer cools down. It will automatically reset, but if the condition still exists, it will shut down again. This prevents transformer burn-out.

Follow the wiring for your model shown on the following pages.

Thermocouple leads should not be run in the same conduit as power leads. Generally the red wire from the thermocouple or thermocouple extension leads is negative. Use only the type of thermocouple specified for your controller range. The range and thermocouple type are shown on the back of the hinge down door on the front of the controller. The thermocouple letter designations are as follows:

J = Iron/Constantan E = Chromel/Constantan
K = Chromel/Alumel R = Plat. 13% RH./Plat.
T = Copper/Constantan S = Plat. 10% RH./Plat.
B = Plat. 6% RH./Plat. 30% RH.

Your controller is equipped with thermocouple break protection. For heating applications, up-scale break protection should be used. If the thermocouple circuit opens, the circuit will drive the display to indicate either a temperature beyond the range of the controller or the display will go blank and an over-range arrow will appear. At the same time, the control output will turn off the heating load. If your control has a second set point, then the second set point relay will also de-energize, except on limit second set point models where low limit was selected, the relay will remain energized.

If, for any reason, down-scale break is required, see "Up-Scale/Down-Scale Thermocouple Break Protection" for selection. In this case, the display will go blank and an over-range arrow will appear and the heat will stay on. The second set point relay will remain energized, except on limit second set point models where low limit was selected, the relay will de-energize.

HOW TO REMOVE PLUG-IN CIRCUIT BOARDS

Particular circuit boards may have to be removed to select various functions as described in the wiring or operating instructions for your model. To remove the circuit board, proceed as follows:

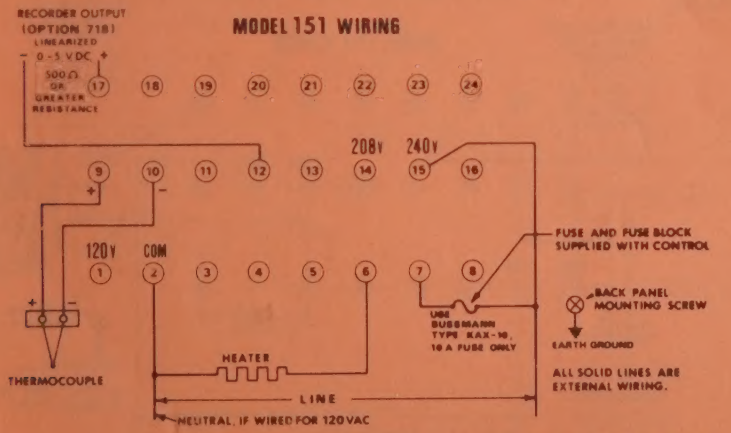
Remove the controller from its housing as described under "Mounting". Remove the desired circuit board by jacking it out of its connector with a screwdriver, inserted through the opening between the chassis side plate and the bottom circuit board, prying against the notched portion of the board. Work it out by jacking from alternate sides.

Replace the circuit board by guiding it between the upper and lower dimples in the chassis side plates. The component side of the circuit board faces the *rear* of the controller. Once it reaches the connector it should be pushed gently into its full plugged-in postion. *Do not force.* Each board is keyed to fit only into its proper position. If it does not mate with its connector easily, it may be in the wrong position or it is not between the dimples.

MODEL 151 WIRING

For Models 1511, 1512 or 1513 see second set point wiring diagrams for wiring of the second set point. Wire main set point as shown below.

The heater load and controller must be powered from the same line phase.



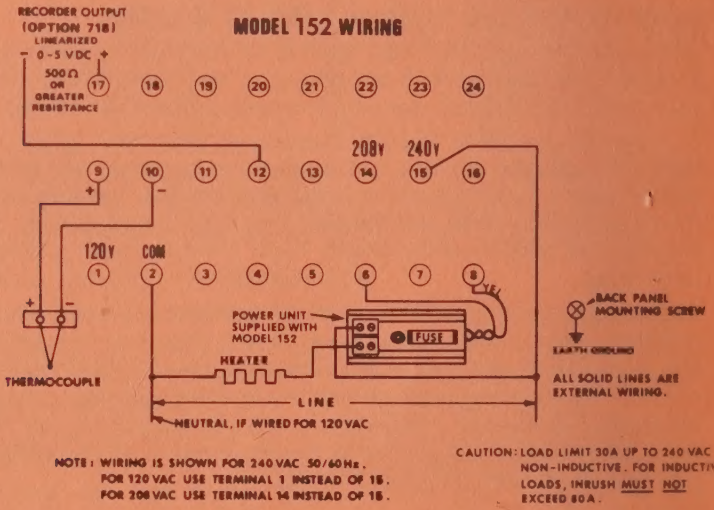
NOTE: WIRING IS SHOWN FOR 240 VAC 50/60 Hz.
FOR 120 VAC USE TERMINAL 1 INSTEAD OF 15.
FOR 208 VAC USE TERMINAL 14 INSTEAD OF 15.

CAUTION: LOAD LIMIT 10A UP TO 240 VAC NON-INDUCTIVE. FOR INDUCTIVE LOADS, INRUSH MUST NOT EXCEED 50A.

MODEL 152 WIRING

For Models 1521, 1522 or 1523 see second set point wiring diagrams for wiring of the second set point. Wire main set point as shown below.

The heater load and controller must be powered from the same line phase.



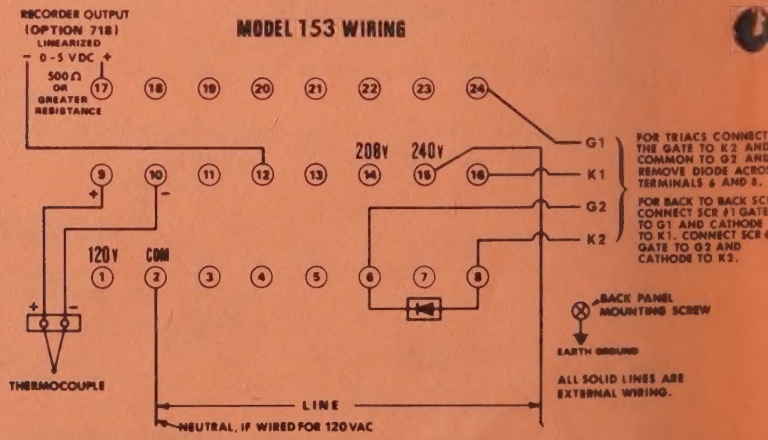
NOTE: WIRING IS SHOWN FOR 240 VAC 50/60 Hz.
FOR 120 VAC USE TERMINAL 1 INSTEAD OF 15.
FOR 208 VAC USE TERMINAL 14 INSTEAD OF 15.

CAUTION: LOAD LIMIT 30A UP TO 240 VAC NON-INDUCTIVE. FOR INDUCTIVE LOADS, INRUSH MUST NOT EXCEED 60A.

MODEL 153 WIRING

For Models 1531, 1532, or 1533 see second set point wiring diagrams for wiring of the second set point. Wire main set point as shown below.

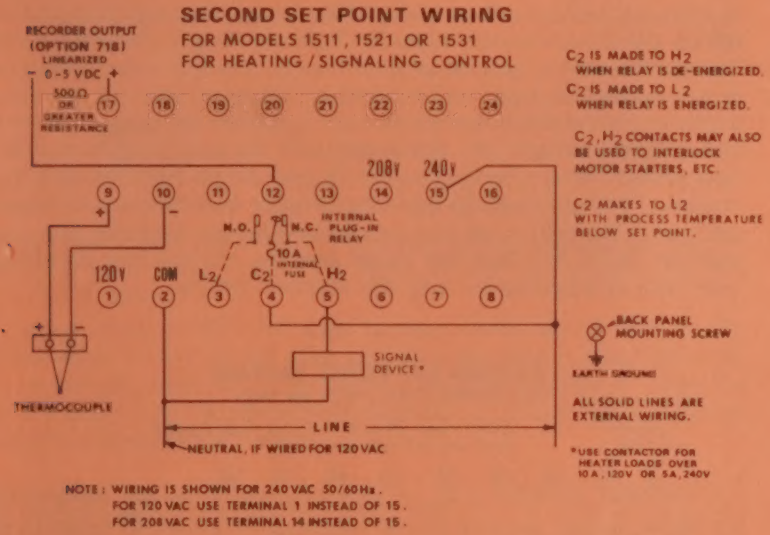
The heater load and controller must be powered from the same line phase.



NOTE: WIRING IS SHOWN FOR 240 VAC 50/60 Hz.
FOR 120 VAC USE TERMINAL 1 INSTEAD OF 15.
FOR 208 VAC USE TERMINAL 14 INSTEAD OF 15.

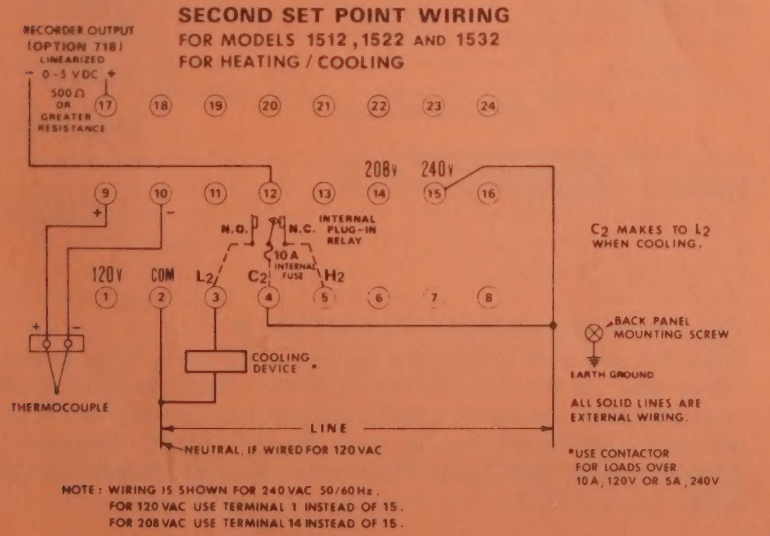
MODELS 1511, 1521 or 1531 SECOND SET POINT WIRING

See Model 151, 152 or 153 wiring diagrams for wiring of main set point.


SECOND SET POINT WIRING
FOR MODELS 1511, 1521 OR 1531
FOR HEATING / SIGNALING CONTROL
RECORDER OUTPUT
(OPTION 718)
LINEARIZED
0-5 VDC
500Ω OR GREATER RESISTANCE
C2 IS MADE TO H2 WHEN RELAY IS DE-ENERGIZED.
C2 IS MADE TO L2 WHEN RELAY IS ENERGIZED.
C2, H2 CONTACTS MAY ALSO BE USED TO INTERLOCK MOTOR STARTERS, ETC.
C2 MAKES TO L2 WITH PROCESS TEMPERATURE BELOW SET POINT.
208V
240V
N.O.
N.C.
INTERNAL PLUG-IN RELAY
10 A INTERNAL FUSE
120V
COM
L2
C2
H2
BACK PANEL MOUNTING SCREW
EARTH GROUND
SIGNAL DEVICE *
THERMOCOUPLE
ALL SOLID LINES ARE EXTERNAL WIRING.
LINE
NEUTRAL, IF WIRED FOR 120 VAC
*USE CONTACTOR FOR HEATER LOADS OVER 10 A, 120V OR 5A, 240V
NOTE: WIRING IS SHOWN FOR 240 VAC 50/60 Hz.
FOR 120 VAC USE TERMINAL 1 INSTEAD OF 15.
FOR 208 VAC USE TERMINAL 14 INSTEAD OF 15.

MODELS 1512, 1522 or 1532 SECOND SET POINT WIRING

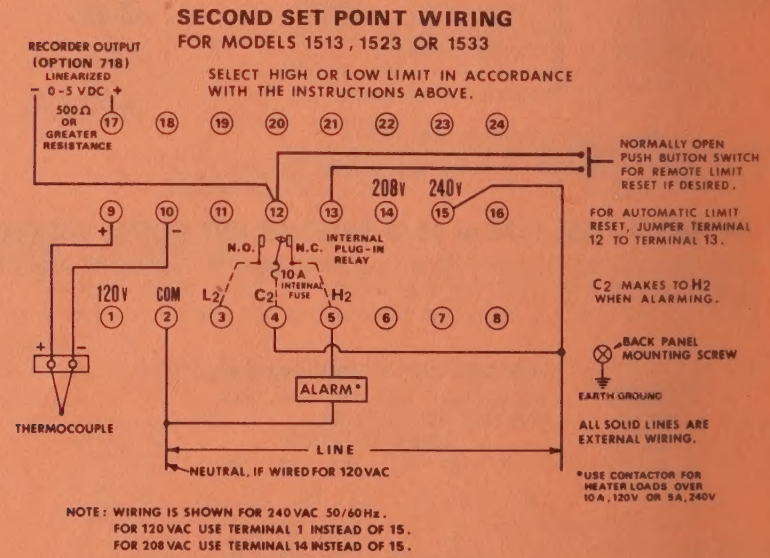
See Model 151, 152 or 153 wiring diagrams for wiring of main set point.



MODELS 1513, 1523 or 1533 SECOND SET POINT WIRING

See Model 151, 152 or 153 wiring diagrams for wiring of main set point.

To wire for *high limit* second set point, remove the controller from its housing as described under "Mounting". Remove plug-in board #6 as described under "How To Remove Plug-In Circuit Boards". Locate the yellow jumper wire on the component side of the board. It is soldered to a pad at one end and plugged into a small receptacle in the board at the other end. It should be plugged in to the receptacle marked "HI". If it is not, pull the wire straight out of the receptacle using a long nosed plier and plug it into the receptacle marked "HI" by pushing the wire straight in. For *low limit* second set point the yellow jumper should be plugged in to the receptacle marked "LO". Replace the board and the control into its housing and wire in accordance with the diagram below.


SECOND SET POINT WIRING
FOR MODELS 1513, 1523 OR 1533
RECORDER OUTPUT (OPTION 718)
LINEARIZED
– 0-5 VDC +
500Ω OR GREATER RESISTANCE
SELECT HIGH OR LOW LIMIT IN ACCORDANCE WITH THE INSTRUCTIONS ABOVE.
17 18 19 20 21 22 23 24
NORMALLY OPEN PUSH BUTTON SWITCH FOR REMOTE LIMIT RESET IF DESIRED.
208V 240V
9 10 11 12 13 14 15 16
FOR AUTOMATIC LIMIT RESET, JUMPER TERMINAL 12 TO TERMINAL 13.
N.O. N.C. INTERNAL PLUG-IN RELAY
10A INTERNAL FUSE
120V COM L2 C2 H2
1 2 3 4 5 6 7 8
C2 MAKES TO H2 WHEN ALARMING.
BACK PANEL MOUNTING SCREW
EARTH GROUND
ALARM*
THERMOCOUPLE
LINE
NEUTRAL, IF WIRED FOR 120VAC
ALL SOLID LINES ARE EXTERNAL WIRING.
*USE CONTACTOR FOR HEATER LOADS OVER 10A, 120V OR 5A, 240V
NOTE: WIRING IS SHOWN FOR 240VAC 50/60Hz.
FOR 120VAC USE TERMINAL 1 INSTEAD OF 15.
FOR 208VAC USE TERMINAL 14 INSTEAD OF 15.

°C. OR °F. SELECTION - ALL MODELS

Decide if you want the display to read in °C. or °F. Open the hinge down door on the front of the controller. With the tip of a small screwdriver or the top of a ball point pen, actuate the °C/°F. selector switch to the left for °C. or to the right for °F. The switch is designed to be operated in this manner to avoid inadvertent operation.

UP-SCALE/DOWN-SCALE SELECTION FOR THERMOCOUPLE BREAK PROTECTION (TCBP) — ALL MODELS

All controllers are shipped with up-scale TCBP. When the controller is used for cooling applications or for low limit operation, down-scale TCBP should be used. To convert to down-scale TCBP, follow the instructions under "How To Remove Plug-In Circuit Boards" and remove circuit board #3. Locate the two short jumper wires colored blue and black on the component side of the board. One end of each is soldered to a pad. The other ends are designed to plug into small receptacles in the board marked (+) and (−). These receptacles are located near the printed circuit board plug-in connector.

For up-scale TCBP (as shipped), the blue jumper is plugged into the receptacle marked (+) and the black jumper is plugged into the receptacle marked (−).

For down-scale TCBP, pull both jumper wires out of their receptacles using a long nosed plier and plug the blue jumper wire into the receptacle marked (−) by pusing the wire straight in. Plug the black jumper into the receptacle marked (+) in the same manner. Replace printed circuit board.

SET POINT RANGE SELECTION — ALL MODELS

The range of set point #1 (main set point) may be field selected for approximately 25%, 50%, 75% and 100% of span (4 break points). For example, a controller having a range of 0-1600°F. type J can have a set point range of 0-400°F., 0-800°F., 0-1200°F. or 0-1600°F. Setting at one of the lower ranges prevents setting the control at a temperature that is too high for the process being controlled and improves set point resolution. The indication span of the control is not affected when limiting the set point range. For controls with a second set point, set point #2 is also not affected and may be set anywhere within the span of the controller.

Some of the small span, special range controls will not have this feature.

As shipped from the factory, the main set point range covers the entire span of the controller. To limit the range, remove plug-in circuit board #4. Follow instructions under "How To Remove Plug-In Circuit Boards". Locate the green jumper on the component side of the board. It is soldered to a pad at one end and plugged into one of 4 small receptacles in the board, marked 1, 2, 3 or 4, at the other end. Pull the wire straight out of the receptacle using a long nosed plier and plug it into receptacle 1 for 25% of span, 2 for 50%, 3 for 75% or 4 for 100%. Replace plug-in circuit board.

HI-LO SWITCH — ALL MODELS

After your set point range has been selected, determine if your set point #1 will be in the upper 50% of the range selected or the lower 50%. If it is in the upper 50%, set the Hi-Lo switch, located behind

the hinge down door on the front of the controller, to the Hi position. Use a small screwdriver tip or a ball point pen to actuate this switch. If your set point is to be in the lower 50%, set the Hi-Lo switch to Lo.

Since there is an overlap between the Hi and Lo settings, a set point selection near 50% of the set point range can be achieved in either of the Hi-Lo switch positions.

SCAN MODE TIMING SELECTION — ALL MODELS

Two modes of display operation may be selected:

1) **Scan mode** — In this mode, the process temperature is displayed for a pre-selected time period of 9.6, 12.8, 16, 19.2, 22.4, 25.6, or 28.8 seconds for single set point controls or 6.4, 9.6, 12.8, 16, 19.2, 22.4 or 25.6 seconds for dual set point controls. After this time period, each set point is displayed for 3.2 seconds. The display will then return to reading the process temperature. This scan will automatically and continuously repeat itself.

2) **Process display only** — In this mode, the display will continuously indicate the process. In either mode the set point(s) may be viewed at any time by actuating the set point switch.

To select the timing of process temperature display, remove circuit board #2. Follow instructions under "How To Remove Plug-In Circuit Boards". Locate the orange jumper on the component side of the board. It is soldered to a pad at one end and plugged into a small receptacle in the board at the other end. These terminals are marked "B", "C", "D", "E", "F", "G", and "I". For single set point controls, B = 9.6 sec., C = 12.8, D = 16, E = 19.2, F = 22.4, G = 25.6 and I = 28.8

For dual set point controls, B = 6.4 sec., C = 9.6, D = 12.8, E = 16, F = 19.2, G = 22.4 and I = 25.6

Pull the wire straight out of the receptacle it is in using a long nosed plier and plug it into the desired timing receptacle.

If you desire the process temperature to be displayed continuously (without set point(s) display) as in mode 2 above, plug the wire into receptacle marked "A" (input only).

A gray jumper wire is also located on this board. For single set point controls, it should be plugged into a receptacle marked "J".

For dual set point controls, the gray wire is plugged into a receptacle marked "H". If you would like to display only set point #1, move this jumper wire to "J". Set point #2 can then be displayed only be actuating the set point switch at any time. If you elect to use the "J" receptacle, the process temperature display time will be the same as that shown for single set point controls.

MODEL 151, 152 and 153 OPERATION

(SEE SPECIAL OPERATION FOR MODEL 1512, 1522 or 1532)

After mounting, wiring, selecting °F. or °C., up or down-scale TCBP,

selecting the set point range and selecting the scan mode timing, power the controller. Actuate the set point switch to "S.P.1" and press in and turn the main set point knob until the display indicates the desired set point temperature. While making this adjustment, "S.P.1" on the display will be lit. Release set point knob and set point switch.

The red light will be lit when the process temperature is below the set point. It will flash at various frequencies as the process temperature reaches the set point, indicating relative power being supplied to the heating load. The red light will go out if the process temperature exceeds the set point beyond the proportional band width.

These models also feature adjustable bandwidth, reset and rate. These adjustments are all located behind the hinge down door on the front of the controller.

Set the rate and reset adjustments to their full counter-clockwise position (off).

Set the bandwidth adjustment to its full counter-clockwise position and allow the process to come up to the desired set point temperature. When the set temperature is reached it will cycle up and down about the set point. The bandwidth adjustment should then be turned clockwise in small steps (wait after each stepped adjustment to see if the process will stabilize) until process stabilizes (temperature remains constant). There may be some offset from the set point, but this will be taken care of by the reset adjustment.

Once the bandwidth has been set, turn the reset full clockwise. Upset the process by moving the set point up or down by about 10% of your controller span. Watch for cycling around the set point when the process reaches this new set point. If no oscillation occurs, turn the reset adjustment counter-clockwise a little and upset the process again by moving the set point back to its original setting. Again watch for oscillation about the set point. Repeat the upsets and counter-clockwise stepped movement of the reset adjustment until oscillation is detected. Then turn the reset adjustment very slightly clockwise and leave it in this position. The best adjustment is the fastest reset time that is possible without oscillation about the set point. Too fast a setting causes oscillaton while too slow a setting will cause long offset recovery time.

The last adjustment should be rate. Turn the rate adjustment to its full clockwise position. Make an extreme upset by turning the set point to a new setting either up or down by about 20% of your controller span. Measure the time it takes for recovery (no oscillation) at the new set point. Turn the rate adjustment counter-clockwise a little and upset the process again by moving the set point back to its original setting. Again measure the time to recover. Repeat the upsets and counter-clockwise stepped movement of the rate adjustment and measuring the time to recover. Leave the adjustment at the setting that gives the fastest recovery time. Too long a rate time

causes excessive system changes resulting in too long a recovery time. Too little a rate time causes a slow system response to process changes.

NOTE: If, after making the above rate adjustment, some instability is noted, the bandwidth may be set marginally too small. Increase the bandwidth by rotating the bandwidth control slightly clockwise.

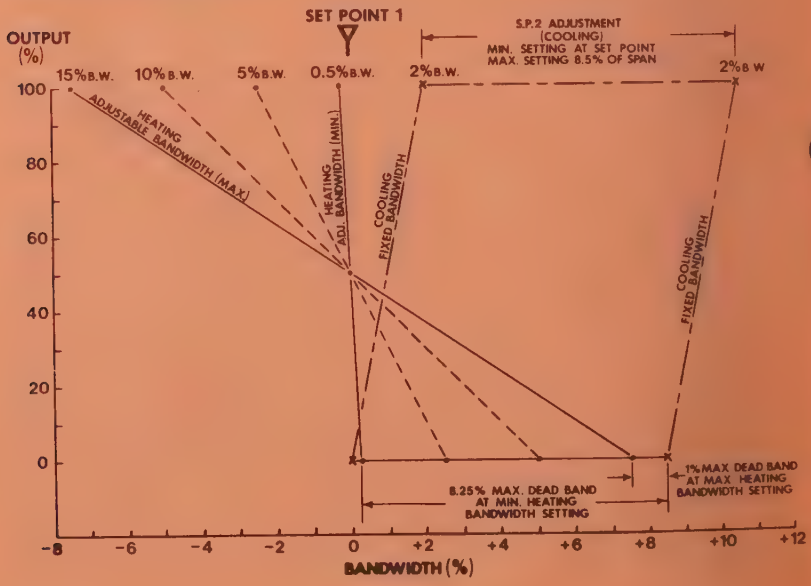
OPERATION OF SECOND SET POINT MODELS 1511, 1521 and 1531

These models have an on-off second set point. This set point is adjustable over 100% of the controller span. To set, actuate the set point switch to "S.P.2" and turn the "S.P.2" adjustment, located behind the hinge down door on the front of the controller, until the display indicates the desired setting for the second set point. While making the adjustment, "S.P.2" will be lit on the display. Release the set point switch. Process temperature will be indicated on the display and input symbol "IN" will also be lit.

The second set point relay is energized (C_2 is made to L_2) when the process temperature is below the second set point setting and the amber light is lit. When the process temperature is above the second set point setting, the second set point relay is de-energized (C_2 is made to H_2) and the amber light is not lit.

MODELS 1512, 1522 and 1532 OPERATION

The adjustment possibilities of Models 1512, 1522 and 1532 are graphed below.



With maximum bandwidth setting of 15% of the heating band and the cooling set point turned up-scale as far as possible, a 1% dead band, no heating or cooling, exists between heating and cooling. Note that if the heating bandwidth is narrowed, the dead band is widened and the cooling set point must be lowered to maintain the same dead band. Once established, the relationship between the heating and cooling bands does not change, since these controllers feature dual reset (integral) circuits which resets both the heating and cooling bands.

The instructions below outline the initial set-up and trimming of all adjustments for optimum control of your heating/cooling process.

After mounting, wiring, selecting °F. or °C., up or down-scale TCBP, selecting the set point range and selecting the scan mode timing, power the controller. Actuate the set point switch on the front of the controller to "S.P.I." and press in and turn the set point knob until the display indicates the desired set point temperature. While making this adjustment, "S.P.I." on the display will be lit. °F.or °C. will also remain displayed. Release the set point knob and set point switch. Process temperature will be displayed and input indicator "IN" will appear on the display. The red light indicates that the process is heating.

Setting of the controller adjustments for the proper heat/cool control may be a matter of trial and error the first time, but should not have to be adjusted once the optimum settings are made.

First determine if your process is fast responding (very low mass or extremely fast heating), or very slow responding (high mass and slow heat-up), or if it has medium response (between fast and slow).

Make the following first settings of the adjustments located behind the hinge down door, then trim in accordance with the instructions given later in this section.

Percent of Clockwise Rotation of Adjustments

Adjustment	Slow Response System	Medium Response System	Fast Response System
S.P.2	100%	100%	100%
B.W. (band width)	50%	50%	50%
Cycle	25%	25%	25%
Rate	25%	25%	50% to 75%
Reset	75%	50%	25%

Allow the process to heat to the set point. If the process requires more cooling than is acheived by simply turning the heat off completely, the process temperature will begin moving above the desired temperature. Watch the red light. The time that the red light is on will shorten in duration. Just at the time when the red light does not come on at all, adjust S.P.2 (cooling set point) counter-clockwise slowly until the amber light turns on. At this time the upper edge of the heating and the lower edge of the cooling bands are coincident. Actuate the set point switch to S.P.2 and

note the temperature setting on the display. The difference between S.P.1 and S.P.2 readings indicate the number of degrees that the lower band edge of the cooling band is above S.P.1 (heating set point). If the process requires some overlap of the heating and cooling bands (cooling will have to overcome some heating), turn the S.P.2 adjustment counter-clockwise a few degrees. If your process requires a dead band (dead intermediate zone) between heating and cooling, turn the S.P.2 adjustment clockwise by the desired number of degrees.

The process is more energy efficient if only cooling is required, but for best control, the cooling band may require some overlap of the heating band especially if your process has excess cooling capability.

When making any of the following adjustments, always allow enough time after each adjustment to see if the process will stabilize.

The *bandwidth* is adjustable from 0.5% to 15% of span for the heating set point and is fixed at 2% of span for the cooling set point. The starting setting for the heating set point in the initial set-up is 50% of clockwise rotation and represents approximately a 7½% bandwidth. The proper setting of the bandwidth is the narrowest possible in order to have minimum overshoot of the set point. The Models 1512, 1522 and 1532 feature anti-windup circuits to prevent massive overshoot on initial heating or when the temperature setting is reduced to a new lower set point. If the bandwidth is set too narrow, the controlled temperature will cycle about the set point on a short term basis. Too wide a setting will cause long term oscillation about the set point. The optimum setting would be wide enough to capture the process with minimal overshoot, but narrow enough so long term oscillation does not occur. If the bandwidth setting is changed from the initial set-up, repeat the adjustment procedure of S.P.2 to maintain the proper relationship between the heating and cooling bands.

Reset is adjustable from off to 15 minutes (off to 0.06 repeats per minute). Slow reset time (longer time period) must be used for slow moving processes (high mass). If the reset time selected is too fast, the reset moves faster than the process, causing cycling around the set point. (If it is set too slow, recovery time after a system upset becomes long. The initial set-up calls for a starting setting of 75% of clockwise rotation, approximately 11 minutes (.09 repeats per minute) for a high mass, slow responding system. The reset may be made slower by turning the adjustment clockwise or it may be made faster by turning the reset adjustment counter-clockwise. Do not make it too fast or cycling about the set point will be experienced.

Rate is adjustable from off to 3 minutes. It is especially helpful in preventing overshooting and undershooting of the set point. If too much overshooting of the set point occurs on the initial startup of

the system, adjust the rate clockwise to increase its effectiveness. Too long a rate time will cause excessive system changes resulting in too long a recovery time. Too little a rate time causes a slow system response to process changes.

Once completely set up, it would be a good idea to record the positions of all adjustments by noting the screwdriver slot position in relation to the tick marks on the overlay plate and also recording the setting, in degrees, of S.P.2 This will allow easy set-up the next time the same process is repeated.

OPERATION OF SECOND SET POINT MODELS 1513, 1523 and 1533

These models have a limit second set point. This set point is adjustable over 100% of the controller span.

For High Limit Operation:
Actuate the set point switch to "S.P.2" and turn the "S.P.2" adjustment, located behind the hinge down door on the front of the controller, to the desired limit temperature *higher* than the main set point temperature. While making this adjustment, "S.P.2" will be lit on the display. Release the set point switch. Process temperature will be indicated on the display and input symbol "IN" will also be lit.

The amber light indicates the operation of the limit set point. Flashing amber indicates a limit condition (limit relay de-energized). When a normal condition exists, the amber light is off. When first powering the controller or when the process temperature exceeds the set point, the amber light will flash. It will continue to flash until the process temperature has dropped below the limit set point *and* the limit reset switch, on the front of the controller, has been actuated.

For Low Limit Operation:
Actuate the set point switch to "S.P.2" and turn the "S.P.2" adjustment, located behind the hinge down door on the front of the controller, to the desired limit temperature *lower than* the main set point temperature. While making this adjustment, "S.P.2" will be lit on the display. Release the set point switch. Process temperature will be indicated on the display and input symbol "IN" will also be lit.

The amber light indicates the operation of the limit set point. Flashing amber indicates a limit condition (limit relay de-energized). When a normal condition exists, the amber light is off. When first powering the controller or when the process temperature drops below the limit set point, the amber light will flash. It will continue to flash until the process temperature rises above the limit set point *and* the limit reset switch on the front of the controller is actuated.

SPECIFICATIONS

INPUT: Thermocouple, thermistor or RTD.

INPUT IMPEDANCE: Greater than 500,000 ohms.

COMMON MODE REJECTION: Greater than 120 DB @ 240 V.A.C. (60 Hz.)

ACCURACY: ±0.25% of span or ±1° whichever is greater (±1 least significant digit).

REPEATABILITY: ±0.1% of span.

RESOLUTION: 1° or 0.1° dependent upon range.

PROPORTIONAL BAND: Adjuststable 0.5 to 30% of span for all models except 1512, 1522 and 1532. For these models, the heating band is fully adjustable from 0.5% to 15% of span. The cooling band is fixed at 2%.

AUTOMATIC RESET (INTEGRAL): Adjustable, off to 15 minutes (off to 0.06 repeats per minute).

AUTOMATIC RATE (DERIVATIVE): Adjustable, off to 3 minutes.

SETABILITY: ±1 least significant digit.

MAXIMUM THERMOCOUPLE RESISTANCE: 300 ohms with rated accuracy.

SUPPLY VOLTAGE: 120/208/240 V.A.C., 50/60 Hz., by terminal selection.

LINE VOLTAGE STABILITY: ±0.2% of span maximum, within 85 to 110% of rated line.

CONTROL RELAYS: Plug-in, 10A (120 V.A.C.), 5A (240 V.A.C.), non-inductive. Single pole, double throw contacts. Two set point controls only.

TRANSFORMER: Plug-in, thermostatically protected.

FUSES: Solid state 10A. output models are supplied with very fast blow fuse, type KAX10 (10A.) and externally mounted fuse block. Solid state 30A. output models are supplied with a power unit fused with a type KAX30 (30A.) fuse.
Common contacts of second set point relays are internally fused for 10A, with 3 AB250 V. fuses.

AMBIENT TEMPERATURE RANGE: 2 to 60°C. (35 to 140°F.) maximum.

TEMPERATURE STABILITY: 7 uV./°C. (4 uV./°F.) maximum.

HUMIDITY CONDITIONS: 0 to 70% R.H. normal operation; 0 to 90% R.H. extreme operating conditions.

THERMOCOUPLE BREAK PROTECTION: Selectable up-scale or down-scale standard.

OPEN RTD PROTECTION: Standard for RTD ranges.

SHORTED RTD PROTECTION: Standard for RTD ranges.

OPEN THERMISTOR PROTECTION: Standard for thermistor ranges.

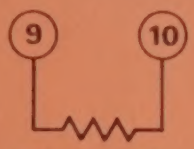
CONTROLLER WEIGHT: Approx. 4 to 5 lbs. depending upon model.

OPTIONS

Built-In On-Off Switch. Option 712. This switch is located on the front of the controller. It disconnects power to the instrument. This is a toggle type switch. Up is on, down is off.

Recorder Output Terminals. Option 718. These terminals provide a linearized output signal of 0-5 V.D.C. into 500 ohms or greater resistance. This signal may be fed to most recorders for aux. recording or other devices monitoring the process temperature. Since the output signal is linearized, a linear chart may be used. This signal may also be used into a digital voltmeter or printer for monitoring. The recorder *should not* have ambient temperature compensation. Recorder or other device should have span and zero adjustments.

Thermistor Input. Option 737. Connect thermistor as shown. All other wiring remains the same. See the wiring diagram for your basic model.

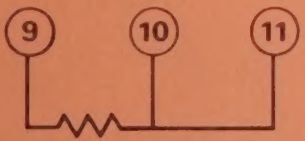


THERMISTOR

Resistance Temperature Detector Input (RTD). Option 738. Connect a three wire RTD as shown. All other wiring remains the same. See wiring diagram for your basic model. If a two wire RTD is used, connect it across terminals 9 and 10 and either:

a) Run a wire from terminal 11 to the side of the probe that connects to terminal 10. This will partially compensate for lead length resistances.

b) Jumper terminal 11 to terminal 10. This method will not compensate for lead resistance.



RTD

Differential Second Set Point Adjustment. Option 748. Second set point adjustable within a range of −30% to +30% of span relative to the main set point. If the main set point is moved, the second set point will follow and hold the same relationship as orginally set.

Rear Terminal Enclosure. Option 717. The enclosure may be used to simply cover the rear terminals or to surface mount the controller. To mount the enclosure to the controller, follow the instructions packaged with the enclosure.

Auto-Manual Station. Option 7501. This option allows manual control of process with bumpless transfer from automatic to manual.

For manual control with bumpless transfer, first locate the auto-manual switch on the front of the controller and the manual adjusting potentiometer behind the hinge down door.

Actuate the Auto-Manual switch to the "BAL." (balance) position and hold it there. The display will indicate a plus (+) number or minus (−) number. If plus, turn the manual adjusting potentiometer counter-clockwise until the display reads zero. If minus, turn clockwise. When display reads zero actuate Auto-Manual switch to "MAN." (manual). When the switch is in the manual position, process temperature may be increased by turning the manual adjusting potentiometer clockwise or decreased by turning counter-clockwise.

To return to automatic control, actuate Auto-Manual switch to "AUTO".

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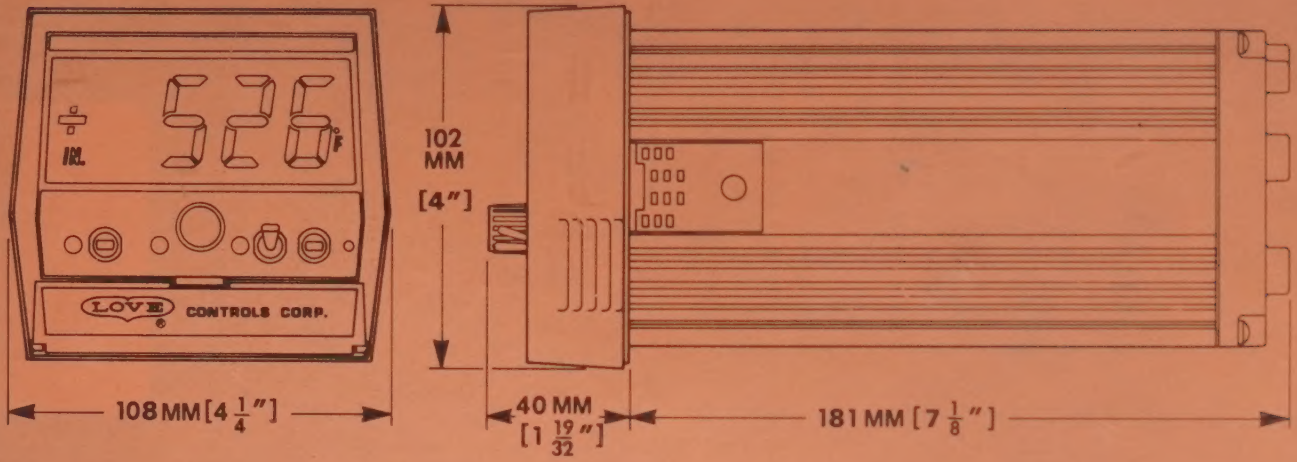
MOUNTING DIMENSIONS



Cutout for all Models 3 5/8" x 3 5/8"
(92 x 92 mm)

WARRANTY

Love Controls Corporation warrants to the Buyer that any equipment sold will be free from defects in materials or workmanship. If, at any time within one (1) year after shipment of Controls or within three (3) months after shipment of thermocouples or other assemblies or parts, the Seller is notified of such defect and the defective item is returned to Seller by Buyer, transportation prepaid, for examination, the Seller will, at his option, either repair or replace the defective items.

This warranty shall be effective only if installation and maintenance is in accordance with Sellers instructions and the defect is not caused by shipping damage, misuse or abuse by Buyer. There are no other warranties, written, oral or implied. The liability of the Seller shall be limited to the repair or replacement of the defective item as above set forth.

Items which wear or which are perishable by misuse are not warranteed. These include contact points, lamps, load SCR's and triacs.

Items in this book are covered by one or more of the following patents: 3, 777, 187; 3, 819, 960 and 4, 161, 679.

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